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A Generalized Crawling-Peg Exchange-Rate System for a Small Open Inflationary Economy

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by

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The purpose of this essay is to present and analyze a short run general equilibrium macro-dynamic model for a small economy, open to foreign trade and to capital movements which lives in a world of inflation (with a domestic rate of inflation greater than in the "rest of the world").

Within this context we want to study one of the proposals that have been advanced in the literature on International Monetary Economics in favor of limited exchange rate flexibility. The proposal has received the name of Crawling Peg or Sliding Parity (Black [3], Meade [25] Cooper [5], Fellner [9], Williamson [35]). It represents a compromise between:

1. The textbook perfect flexibility of exchange rates that keeps at all time a zero excess demand for foreign exchange without any need for buffer stocks of foreign reserves, and
2. The perfect fixed exchange rate system that relies on adjustment of variables different from the exchange rate in order to keep equilibrium in the foreign exchange market.

As it is well known the Crawling Peg is a proposal born to life because of the failure of the system created in Bretton Woods in 1945 and formally dead in Jamaica early in 1976, which turned out to be the worst possible

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compromise between the two polar exchange rate systems mentioned above. In practice the system of "fixed exchange rates" soon became a system of "adjustable pegs" in the presence of "fundamental disequilibrium" when the situation in the foreign exchange market was no longer tolerable.

Within the experience of several semi-industrialized developing countries of Latin America, the Bretton Woods system was frequently equivalent to the maintenance of overvalued nominal exchange rates for prolonged periods of time with the implicit taxation on exports and subsidies on imports of goods and services that overvaluation implies.

The resulting chronic multimarket disequilibrium state led to all types of controls over trade and capital movements that the Economic History of the period perfectly documents. When devaluation becomes unavoidable the JUMP in the exchange rate was so strong that economies were often subject to all sorts of violent adjustment in market variables.

The crawling Peg proposal that we want to analyze is one in which the rate of depreciation (or appreciation) of the domestic currency, also called the rate of the "crawl", is a policy variable that is limitedly altered in response to some objective indicators of balance of payments disequilibrium. It is a system that has been and is being actually experienced by some Latin American countries (like Brazil, Chile, Colombia and Argentina,[1]) under the name of "minidevaluations" within a general policy of "gradualism".

Nevertheless and to my knowledge, the theoretical or analytical properties of the crawling peg system has not been the subject of explicit

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[1] See Robichek and Sanson [29], Carrasco and French Davis [4] Diaz Alejandro [7], Fishlow [10], among others. See also M. Suplicy [23] for an econometric study or the Brazilian experience of minidevaluations.

dynamic analysis.

That is, in the analysis that follows we will not be looking for the comparative statics properties of the proposal, deriving accordingly the precise conditions for successful "minidevaluations" in our multimarket framework, as it has become traditional in general devaluation analysis.

We ask instead the following question: Under what conditions is it possible that a crawling peg system of exchange rate management does not generate hyperinflation?

More precisely: given the assumption that minidevaluations will directly increase domestic costs over time (via increases in money wage rates and absolute domestic prices of imported inputs), will the resulting wage-prices-exchange rate spiral converge over time to some equilibrium value?

We shall see that under certain conditions it is possible to give an affirmative answer to the problem, even when private economic agents and the public sector are free of money illusion in the conventional sense.

II. RELATION WITH THE EXISTING LITERATURE ON DEVALUATION THEORY

The analysis of "minidevaluations" obviously belongs to the theory of devaluation within international monetary economics.

The topic, or related aspects of it, has been the subject of some (verbal) convergence conjectures by several authors[1], and of a brief algebraic treatment by Cooper [6].

We also mention a useful dynamic outline by Arndt [2] and a recent dynamic study of the crawling peg by Levin [20] within the context of the policy assignment problem in balance of payments theory.

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[1]Among them, see Cooper, R. [6] and Giersh H. [12].

Let us then try to situate the model to be presented below within the existing literature on devaluation analysis. It is today generally accepted, although it took some time to arrive at this point, that devaluation, as one among several possible expenditure switching policy tools, is essentially a monetary phenomenon. This is true although not in the limited sense provided by any induced real cash balance effect on total domestic absorption.

It is a monetary phenomenon in the more fundamental sense that in order to study it properly we need models in which money enters in some relevant way, not only as an abstract unit of account as in the "pure" theory of trade but also as medium of exchange and (sometimes) as an asset or store of value. The monetary aspects of devaluation analysis followed from Alexander contribution or absorption approach [1], whose main message has been to recognize that an excess demand for foreign exchange on current account at a given exchange rate, is identically equal on the one hand, to the excess of domestic absorption over national product and on the other hand to the negative net dishcarding which may be observed ex-post through the decline in the stock of foreign reserves of the Central Bank.

Within this context the model to be presented below can be compared with two sets of previous contributions which represent two alternative theoretical ways of integrating real and monetary sectors in the open economy.

1. The first set is provided by the Meade-Tsiang [33] model which integrates for the first time in 1961 relative prices, income-absorption analysis and

(early) Keynesian monetary theory in the study of devaluation under both full and less than full employment conditions.[1]

2. The second set is provided by the new monetary Hume type approach to balance of payments analysis and in particular to devaluations, which integrates the real and monetary sectors of the open economy by applying Classical (Quantity) Monetary theory. We may distinguish here in turn between an extreme version and a moderate version of this approach.

The extreme version[2] considers the "pure theory of devaluation" as a special case of classical monetary theory. Hence the effects of devaluation are found to be completely innocuous since under a "stable money supply process" and a "stable money demand function" the economic system returns to the pre-devaluation levels of all real variables including relative prices. One may wonder here about the "rationality" of the change in the exchange rate. Why would a Government ever want to devalue the domestic currency knowing in advance that it will be the main responsible for allowing the cancellation of all its real effects by maintaining a (gold standard type) stable money supply process?

A much less extreme version of this approach integrated in the 70's relative prices, income-absorption analysis and classical quantity monetary theory in the analysis of devaluation under full employment conditions.[3] The long run effects of devaluation also turn out to be money neutral through the cash balance effect, although the conclusion alters when departing from an initial deficit on current

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[1] The sectorial breakdown of this model (a "large" country model) into a domestic sector (which includes exportable goods and nontraded goods as a composite Hicksian bundle of commodities) and importables which are consumed but not produced at home is not a crucial assumption at all, as the more complete four commodity model of James Meade [24a] shows in his monumental work of 1951. Salop, J. [30] extended the Meade-Tsiang framework to consider a classical labor supply function sensible to real wages. This model should also be considered as an effort to integrate real and monetary analysis (Keynesian early monetary theory) for the open economy.

[2] See Kuska [19] and Johnson [17] among others.

[3] See Dornbush, R. [8], Mundell [26] and Mussa [25] among others.

account.[1]

Several features distinguish the crawling peg model to be presented in the next section from both sets of monetary models of devaluation.

It differs from the Meade-Tsiang model on the one hand in the following aspects:

--The money supply is in part endogenously determined

--The process of price formation is assumed in part to be non-competitive.

--The sectorial breakdown of the economy corresponds to the small country assumption popularized in international economics by the Australian economists Salter [31], Swan [37].

--Inflationary expectations are introduced and a distinction is assumed to exist between anticipation of inflation, which refers to the ability of the market to accomodate expectations, and expectations of inflation which refer to the inner beliefs of economic agents regarding the time path of the price level.

--The Government sector is explicitely incorporated in the analysis and, finally,

--The core of the study centers on the dynamic stability properties of the crawling peg instead of the comparative static properties of a once and for all change in the exchange rate as it is usual in both sets of models.

On the other hand it differs from the second set of devaluations models already mentioned in one important point. Since they rely on the modern quantity theory of money, they seem to have found in the small country assumption a "natural" justification to have externally given interest rates.

If a country is small because it is a price taker in commodity markets then it must also be small--so the argument seems to be--in international capital

[1] One wonders here also why the (gold standard) stable money supply process is not allowed to work in reverse through the liquidity effects induced by the decline in the stock of foreign reserves at the hands of the Central Bank. The devaluation becomes also redundant policy tool in this case of initial trade balance deficit.

markets so that the interest rate is a world determined price.

Nevertheless the analysis that follows recognizes that there is no logical or theoretical justification to extend the small open economy assumption to trade in financial or paper assets between countries. To assume that domestic interest rates do not deviate from world levels implies to assume a sort of perfect international acceptability of domestically issued financial assets an assumption that runs counter we think, with the small country hypothesis.

Consequently our small open economy faces an externally given foreign interest rate and has a domestically determined interest rate so that short term capital movements or uncovered interest arbitrage schedules are not perfectly elastic.

III. THE CRAWLING PEG MODEL

Let us now describe the building blocks of the model within which the dynamic viability of the crawling peg proposal will be analyzed. In the sequel, all variables are dated at time t, omitted to simplify the notation.

Starting with the real sector, the economy produces exportables, importables and nontraded or pure domestic goods, under conditions resembling those of the Salter model [31]. That is, total output or the aggregate volume of domestic production of goods and services, Y, assumed to be given at full employment of domestic resources, is divided between:

- the traded goods sector or international sector, i, in which money prices, $\bar{P}i$, in terms of foreign currency are determined in world markets. It is assumed to be a commodity bundle, composed of importables, defined as the difference between home consumption and production of commodity M, and exportables defined as the difference between home production and home consumption of commodity X.

If the foreign prices of both classes of traded commodities are determined in world markets, it means that both the foreign demand function for exportables and the foreign supply function of importables are perfectly price elastic at least in the relevant range.

Then the terms of trade, defined as the ratio of the money prices of exports and imports, quoted in either domestic or foreign currency, will remain constant and unaffected by domestic events like the minidevaluations. Consequently the international good or traded good i can be considered as a Hicksian composite commodity, and its money price in terms of domestic currency P_i can be expressed as the product of the foreign currency price and the exchange rate, r, defined as the unit price of the foreign currency in terms of domestic currency. That is,

$$(1) \qquad P_i = r\,\bar{P}_i$$

This is true due to space arbitrage with zero transport costs and zero tariffs but the analysis could obviously include a positive rate of transport costs and tariffs as long as both remain constant over time.

\- The nontraded good sector, or home sector, produces also a composite final commodity h whose price is determined entirely by conditions of internal costs and demand. That is, it includes services, the professions, building industry, health, education, etc, so that the market equilibrium condition requires a zero domestic excess demand.

Nevertheless it is not a vertically integrated sector since it is assumed that it requires imported goods as intermediate inputs. In this sense our nontraded goods sector is not completely a sheltered sector as it is in the Salter model.

Consequently, the domestic currency price of home goods, P_h, can be expressed from the cost of production side of the Marshallian scissor as:

$$(2) \qquad P_h = as + bP_i$$

where s denotes the rate of money salaries or wages per unit of time. The coefficients a and b denote the reciprocal of the average labor productivity and the intermediate input requirement per unit of output, respectively. If we give to (2) a mark-up type of pricing process interpretation, then the coefficients a and b must be considered as corrected by a profit margin. We would be in the Hicksian short run fix price market economy.[1]

Alternatively we may try to give to (2) a competitive pricing interpretation in which case a and b could be considered as marginal as well as average technological coefficients, with a stock of physical capital given in the short run in both sectors. This constancy can be explained if we recognize that there exists in the short run transactions costs to firms (firing costs, hiring costs and on the job training costs) which do not allow firms to move costless between a continuum of productive techniques.[2] Let us observe that this division of the

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[1] See Hicks, J. [14] and [16].

[2] Under this second possible interpretation, the crawling peg policy will ensure continuous full employment of the stock of primary factors of production with changes in the value composition of output and total expenditure (or aggregate domestic demand) but without changes in the physical composition of total product. The composition of aggregate domestic demand is free to alter both in physical and value terms.

productive structure between traded and nontraded sectors implies that for balance of payments purposes it is indifferent whether an increase in the production of traded goods is achieved by means of an increase in the home production of exportables or by an increase in the home production of import substitutes. This is true because the constant terms of trade allows a linear transformation function through international trade between exportables and importables. Hence the nominal balance of payments on current account is identically equal to the difference between the value of domestic production and domestic expenditure on internationally traded goods, i.e., the difference between the value of exports and imports.

Let us now describe the demand side of the model. The volume of aggregate domestic demand or total domestic real absorption E, measured by a general price index to be defined later, is expressed by the following accounting identity

$$(3) \qquad E = Y + M - X$$

That is, E represents total real expenditure on commodities produced at home (traded and nontraded goods) as well as on foreign produced goods or imports M, by domestic residents of the small economy for purposes of consumption and investment both private and public.[1] The identity relates E with the sum of gross national product at full employment Y and the import surplus, which means that exportables, X, are included in the total product but are

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[1]That is, it includes Government expenditure.

subtracted from M to obtain the aggregate domestic demand.

What determines the behavior of aggregate domestic demand in the open economy? The composition and the level of total real expenditure between home made goods (exportables, importables and nontraded commodities) and foreign made goods or imports is assumed to depend on real income, the real interest rate, i, and relative prices, the latter expressed as the ratio between the domestic currency prices of nontraded and international traded goods.

$$(4) \qquad E = E\left(i, \frac{P_h}{P_i}, Y\right) \qquad\qquad E_1 < 0,\ E_2 < 0,\ E_3 > 0$$

That is, aggregate domestic absorption responds negatively to the first two independent variables and positively to real income.[1]

The sign of the first partial derivative is due to the investment component of total expenditure and the relevant variable is the real interest rate. Otherwise the sign of that partial derivative could be positive where the rise in the money interest rate coexists with a positive rate of inflation of commodity prices (to be defined later).

The sign of the second partial derivative admits that aggregate domestic demand by firms and households for traded commodities, i, has a lower price elasticity than for nontraded commodities, h. That is, it seems reasonable to assume in this economy that an increase in the relative price of h - caeteris paribus - diminishes domestic demand for the nontraded good component to a larger extent than the relative decrease in the money price of traded goods i increases total demand for traded goods.[2] This follows from the technology

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[1]The third partial derivative is not needed at full employment.

[2]Discarding inferior goods in these aggregates.

inplicit in equation (2) since foreign produced goods (imports) are mostly intermediate inputs.

In what follows and as it is usual in short run models, the length of the time period is such that the flow of investment activity per unit of time is supposed to make only a negligible addition to the historically given physical capital stock in each sector.[1]

We see that function E is free of money illusion since it is homogeneous of degree zero in money prices and money income. Finally we can write the equilibrium condition in the market for goods and services, or zero total excess demand condition:

(5) $Y = E + B$

where B denotes the net foreign demand or surplus of the balance of trade. It says that the total supply of commodities produced domestically must equal the aggregate domestic demand on home and foreign produced goods plus the surplus of the balance of trade.

Let us now describe the composition of the financial assets of the economy including the money market and the foreign exchange market.

Three types of paper assets are demanded by domestic residents:

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[1]Admittedly this is only a simplification of an otherwise too complex analysis. A complete portfolio balance approach to international adjustment should consider the physical and financial asset stock decisions related to the allocation of total private wealth as well as the private spending flow decisions. See Tobin, J., [32] for the closed economy case. In our present case this should also be extended to the asset stock decisions of the Gpvernment sector regarding foreign reserves.

- domestic money, i.e., a liquid asset(domestic currency and demand deposits) which commands a zero nominal own rate of return and a real rate of return equal to the inflation rate of commodity prices with negative sign.[1]
- domestic securities, issued by both the government and firms, with a nominal rate of return equal to the money rate of interest, i_M, and a real rate of return equal to the money interest rate minus the rate of inflation.
- foreign securities issued by the foreign trading country or "rest of the world", with nominal and real rate of return equal to the foreign given money interest rate.

The international short term private capital flows to be described below represent trade in securities between the two countries. The interest arbitrage schedule is assumed to be less than perfectly elastic due to imperfect sub-sitution between the two financial assets in foreign and domestic preferences. The analytical price to be paid for introducing this more realistic domestic-foreign asset substitution hypothesis is that the portfolio composition of domestic residents at any moment consists of either domestic or foreign securities plus money since the foreign interest rate is exogeneous. The justification of a diversified portfolio needs the explicit introduction of risk in the asset decision making process as it has been done by Grubel [13] and Levin [20] in the theory of short term international capital movements.[3]

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[1] The inflation rate of commodity prices in turn can be considered as the own-rate of return (positive) on physical goods.

[2] We assume for simplicity that the smaller external inflation rate is zero.

[3] The assumption of perfect mobility of financial capital flows between countries (or perfect substitutability of domestic and foreign securities) determines only one externally given interest rate and a diversified portfolio composition for domestic residents. This is the usual assumption of perfect arbitrage used by all monetarists models of international adjustment.

Then we may write the demand function for real money balance, L, as a portfolio behavior function for the liquid asset as:

$$(6) \qquad L = L\,(i, \pi, Y) \qquad\qquad L_1 < 0,\ L_2 < 0,\ L_3 > 0,\ \frac{L\pi}{Li} > 1$$

where π denotes the expected rate of inflation of commodity prices, and i the real interest rate.[1]

How can we justify this function as well as the indicated signs for the partial derivatives?

Let us introduce first an equation that relates the domestic nominal and real interest rate and which "resembles" the well known Fisherian hypothesis through which Fisher explained the Gibson paradox:

$$(7) \qquad i_M = i + \pi$$

That is we assume that credit markets are such that there exists a sort of instantaneous arbitrage between stocks (equities) and securities which equalizes without lags their nominal rates of return.

Alternatively stated, there are no institutional ceilings to the nominal borrowing and lending rates and this is a crucial necessity for the viability of any crawling peg exchange rate system.

Any other hypothesis would mean the economy will lose on capital account what it gains on current account of the balance of payments with any upward

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[1] The asset demand function for domestic securities will have the same explanatory variables and is omitted by Walras Law. The behavior of international net movements of short term capital will take the place of an explicit foreign asset demand function, for simplicity.

expected crawl of the rate of exchange.[1]

In other words, equation (6) could be deduced from a more complete financial assets structure assuming that the demand for nominal cash balance F is a function of the nominal own and cross-rates of return on securities and equities (stocks):

$$(8) \qquad F = F\,(i_M,\ i+\pi,\ \pi). \qquad\qquad F_1 < 0,\ F_2 < 0,\ F_3 < 0$$

with all the partial derivatives negative due to the assumption of gross substitution among assets including money.

If we use the instantaneous arbitrage relation (7) then it becomes clear that (8) can be written as:

$$F\,(i+\pi,\ i+\pi,\ \pi) = L\,(i,\ \pi)$$

Furthermore, $L_1 = F_1 + F_2 < 0$, that is, an increase in the real interest rate, for given π, increases the real rates of return of both alternative assets and hence decreases the demand for real money balances.
Finally, $L_2 = F_1 + F_2 + F_3 < F_1 + F_2 < 0$
because of gross substitution.

An increase in π, with constant real interest rate, increases the nominal yield of all remaining assets decreasing the real return in money.

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[1]It is well recognized that the interest-rate constraint under the crawling peg would not give rise to the distorted incentives for international capital movements discussed by Lutz, F. [21] under the Bretton Woods fixed exchange rates.

This is so because high nominal interest rates need not be high real rates which would have deterrent effects on domestic investment. See Willet, T. et al., [34].

It is easily derived that $L_2/L_1 > 1$ The sign of L_3 represents the Keynesian assumption of a positive but smaller than one income elasticity of the money demand function since transactions balances are only a part of total money holdings.

The supply side of the money market is described as follows.

Let us define the nominal monetary base M, as the value in domestic currency of the stock of foreign exchange reserves of the Central Bank, and the accumulated budget deficit.

$$(9) \qquad M = rR + \int T$$

where R denotes the actual stock of foreign exchange reserves, r the rate of exchange and T the nominal budget deficit per unit of time.

Under a fractional reserve banking, we can also write the nominal money supply, D, as a proportion k of the monetary base.

$$(10) \qquad D = k\ M \qquad , \qquad k \geq 1$$

On the other hand, the budget deficit per period is defined as the difference between the level of nominal public expenditure and income, where t denotes the tax rate and $\bar{G}$ is a policy exogeneous variable

$$(11) \qquad T = P\ \bar{G} - t\ P\ Y$$

We see then that the money supply is in part exogeneously determined by the monetary authority which decides the size of the real budget deficit per period. Monetary policy on this account is the monetary consequence of the fiscal policy.

But the money supply, in this study of limited flexibility of the exchange rate, is in part endogeneously determined by the liquidity effects of the balance of payment surplus through the induced change in the stock of foreign reserves.

Then the money supply process is seen to be an intermediate case between the active money and the passive money models,[1] and this, we think, seems to be necessary for the analysis of the crawling peg in an inflationary economy.

The money supply is "active money" through the exogeneously given budget deficit and it is "passive money" through the monetization of the balance of payment surplus at a given exchange rate.

Strictly speaking an increase in the budget deficit involves also "passive" monetary policy through the associated increase in Government borrowing. We want here to point out that the active money ingredient of the model's money supply stems from the exogeneously given size and rate of change of the budget deficit.

We may write then the equilibrium condition in the money market as

$$(12) \qquad \frac{D}{P} = L\ (i, \pi, Y)$$

where P denotes the general price level, defined as a weighted average or composite of the two money prices

$$(13) \qquad P = d\ P_i + f\ P_h$$

[1] See Olivera, J. [27].

We have chosen to define P as a particular function homogeneous of degree one in both money prices and with positive partial derivatives. Alternatively we could have adopted the usual procedure of defining a numeraire (like traded goods) and express all real quantities of the model in terms of that particular commodity. This would be exactly equivalent to a "general price index" like (13) with zero weight for one commodity.[1] Furthermore, under inflation changes in weights due to changes in the exchange rate, can be considered of second order of smallness.

The desc:ption of the money market in the open economy is not complete unless the foreign exchange market is introduced. We have seen that the surplus in the balance of payments is part of the endogeneous side of the money supply through the monetization of the corresponding change in foreign reserves.

The balance of payments surplus in turn is composed of the balance on current account and on capital account, so that the equilibrium condition in the foreign exchange market can be expressed in terms of foreign currency as:

$$(14) \qquad \dot{R} = B\ P_i + K$$

where R denotes the change in the stock of foreign reserves of the Central Bank, B denotes the surplus on current account and K the net capital inflow of short term capital.

The net inflow of short term capital per unit of time or net foreign

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[1] This particular price index meets the requirement of being able to capture changes in utility levels brought about by changes in the price components. See Salop [30].

demand for domestic bonds is assumed to be responsive to the real rate of return of the capital flow, i.e., :

$$(15) \quad K = K\,(i_M - \dot{r}/r) \qquad , K' < 0$$

The real rate of return of the capital flow is defined as the difference between the money interest rate and the expected rate of the crawl of the exchange rate. For a given i_M, an increase in the expected minidevaluation will induce a capital outflow (a net domestic demand for foreign securities). And, for a given exchange rate, an increase in the nominal domestic interest rate with respect to the given world money and real interest rate, will give rise to capital inflows (a net foreign demand for domestic bonds and a net sale of foreign bonds by domestic residents)[1]

Let us notice the nature of the crawling peg model. If the exchange rate were completely flexible, it would be just that price of the foreign currency at which the change in the stock of foreign reserves would be exactly zero at any time period.

Hence the important matter to consider next is the determination of the rate of the crawl over time, as well as the determination of nominal salaries.

Let us start with the last variable, money salaries, and ask about the forces that are assumed to influence their determination.

We could have assumed as is usual a constant money wage rate, and so rely on money illusion as the burden of the dynamic adjustment process.

Instead we assume the following adjustment mechanism for money wages. Call s, the actual rate of money wages or salaries; $\ddot{s}$, the rate of real wages;

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[1] See footnote No. 1 on page 9. For simplicity we are assuming the stocks of foreign and domestic bonds owned by domestic residents as exogeneously given. One justification for this omission would run parallel to the definition of the period in relation to the current stock of wealth and physical capital. Portfolio decisions only alter the composition of existing portfolios.

s^o the rate of desired wages; u and v two positive constant adjustment velocities.

Then we have that the rate of money wages can be expressed by means of the following differential equation:

$$(16) \qquad \frac{\dot{s}}{s} = v\,(s^o - \bar{s}) + \mu\,\pi \;, \qquad \mu \leqq 1$$

It says that money wages or salaries are adjusted with a lag (equal to the reciprocal of v) to the gap between desired and actual salaries on the one hand (both real rates) and to the expected rate of inflation of commodity prices, π, on the other hand.

The adjustment to π will be full if μ equals one. Actual real wages are obtained by deflating nominal wages by the general price level already introduced.

How can this adjustment function for nominal wages be justified, irrespective of the state of excess demand of the labor market? First of all let us notice that we could have used the walrasian type of adjustment behavior implicit in the Phillips curve.[1] We wanted instead to study the viability of the crawling peg model under the existence of an independent backlash of prices on wages, as a way of recognizing the modern phenomenon that Sir J. Hicks christened as the Principle of Real Wage Resistence.[2]

The salary earner's test for a notion of "fair wages" implicit in the principle of real wage resistence is not only a comparison with other people's

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[1]This is worked out in a forthcoming paper with allowances for less than full employment trade-offs.

[2]See Hicks, J., 1975, [15] and 1974, [16]. In a context of economic growth analysis the Principle is stated in terms of shares of labor in G.N.P.

earnings, but also a comparison with his own experience in the past.

One should read here beyond a mere "institutional assumption" or a scøiological interpretation of inflation.[1]

In a dynamic setting, a long experience of rising commodity prices leads workers to look at the purchasing power of their money wages and not simply at the level of money wages. The existence of labor union power simply reinforces an otherwise independent notion of a "fair wage".

Let us now explain the adjustment of the exchange rate. It is assumed that the Government has a Reaction Function[2] which incorporates the crawling peg policy for the exchange rate.

The rate of exchange is altered as a function of the gap desired-actual stock of foreign exchange reserves, $(R^{\circ} - R)$, and the expected inflation rate π:

$$(1.7) \quad \frac{\dot{r}}{r} = n(R^{\circ} - R) + \sigma\pi, \ \sigma \leq 1$$

where n and σ again denote the positive constant velocities of adjustment. The smaller n, the slower is the Government to adjust r to the change in the stocks of reserves. A value of σ equal to one, indicates a full adjustment of r to the current repected rate of inflation.

Sometimes the crawling peg as a policy of limited flexibility for the exchange rate, has been criticized because of a possible built-in rigidity.

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[1]See for example the recent survey of Inflation Theory in Parkin and Laidler [28].

[2]The name has been used by Arndt, S. [1].

The question may arise regarding the possible consequences of a movement over time in the equilibrium exchange rate that is faster than the maximum allowable crawl.[1] This would be represented in a value for the coefficient of adjustment of the crawl to the expected inflation rate of less than unity. In our context this rigidity does not arise at all because when the value of σ is less than one, the stock of foreign exchange reserves would decline and this loss would trigger in time - caeteris paribus - further gradual changes in r.

The model is finally closed with two alternative hypothesis for the generation of expectations regarding the rate of inflation of commodity prices.

We have assumed as a first alternative that the actual current inflation rate is expected to persist over time by both the private and public sector of the economy. That is,

$$(18) \qquad \pi = \frac{\dot{P}}{P}$$

As a second alternative we have postulated the adaptive expectations model, in which expected price changes are a weighted average, with exponentially declining weights, of actual current and past price changes. As is well known, this hypothesis implies that expectations of inflation are adjusted or adapted over time in proportion to the forecasting error (or actual experience) at a constant positive velocity. That is:

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[1]See Krueger, A. [18].

$$(19) \quad \dot{\pi} = \beta \left(\frac{\dot{P}}{P} - \pi \right), \qquad \beta > 0$$

Furthermore along the stability analysis of the next sections different combinations in the values of coefficients μ and σ have been permitted as a way of distinguishing between anticipations and expectations of inflation.[1]

This completes the description of the model of seventeen endogenous and six exogeneous variables within which the stability of the crawling peg proposal will be studied.

Let us notice that we are analyzing the proposal within a model that admits different adjustment velocities over time for the involved market price variables, namely, money salaries, domestic commodity prices, nominal interest rate, rate of exchange, and expected inflation rate.

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[1]The importance of this distinction is emphasized in Genberg, H. and Swoboda, A., [11]. There may be institutional restrictions to accommodate expectations of inflation even if they are correctly generated, (ceilings to nominal interest rates, etc.).

IV. STATIONARY EQUILIBRIUM CONDITIONS

The conditions for the equilibrium solution of the model can be explored if we first reduce it to more manageable dimensions.

In order to do it let us differentiate equation (9), which expresses the monetary base, in order to be able to work with Δ, the constant real budget deficit per period instead of the accumulated deficit.

Furthermore to facilitate the stability analysis we introduce as numeraire the currency of the rest of the world called "bancor" subject to a zero external rate of inflation.

Then from now on the general price level P, the price of nontraded or domestic goods P_h and the money wages s are expressed in terms of "bancor" and the original model is reduced to the following system of three static and three dynamic equations.

(1) $\dot{m} = (\rho R + \dot{R}) \dfrac{1}{\varepsilon + \zeta s} + \dot{\Delta} - m\pi$

(2) $km = L(i, \pi, Y)$

(3) $\dot{R} = B(i, as + \beta) - K(i + \pi - \rho)$

(4) $\dfrac{\dot{s}}{s} = v(s^{\circ} - \bar{s}) + \mu\pi - \rho$

(5) $\rho = n(R^{\circ} - R) + \sigma\pi$

(6) $\pi = \rho + \dfrac{\zeta s}{\varepsilon + \zeta s} \dfrac{\dot{s}}{s}$

where m denotes real money balances, ρ denotes the rate of the crawl for the exchange rate, i.e., $\rho = \dot{r}/r$; $\zeta = fa$, represents the weight of direct and indirect wages in the general price level; $\varepsilon = d + fb$ represents the weight of direct and indirect wages in the consumer price index used to obtain real wages, $\bar{s}$.

We can further simplify this system by solving partially the last three equations for the variables π and ρ. For this purpose the two gaps of the model, i.e., the gaps in the international reserves $(R^{\circ} - R)$ and in wages $(s^{\circ} - \bar{s})$ can be normalized in order to facilitate comparisons between themselves and with the rate of inflation:

Then let us define

$$z = \frac{n}{1 - \sigma} (R^{\circ} - R)$$

$$y = \frac{v}{1 - \mu} (s^{\circ} - \bar{s})$$

Then it is possible to express the rate of inflation π as a weighted average of z and y with weights that depend on nominal wages

$$\pi = \xi z + (1 - \xi) y$$

where $$\xi = \frac{\varepsilon(1 - \sigma)}{\varepsilon(1 - \sigma) + \zeta s (1 - \mu)}$$

Let us now study the stationary equilibrium solution of the reduced model. By definition:

$$\dot{s} = \dot{R} = \dot{m} = 0$$

Then we find that

$$y = z = \pi = \rho$$

and the system is reduced to the following three equations in π, s and i.

$$(7) \quad (R^{\circ} - \frac{1 - \sigma}{n} \pi) \frac{1}{\varepsilon + \zeta s} + \frac{\Delta}{\pi} = \frac{1}{k} \; L\,(i,\pi,Y)$$

$$(8) \qquad B(i, as + \beta) + K(i) = 0$$

$$(9) \qquad \pi = \alpha \frac{s^{*} - s}{\gamma + \delta s}$$

The third equation which determines the stationary equilibrium represents the equilibrium relationship between the expected rate of inflation and is obtained from the equality between π and y.

Furthermore it can be seen that in equilibrium, the desired real wage s^{*}, becomes:

$$s^{*} = \frac{\gamma s^{\circ}}{1 - \sigma_1^{\circ}}$$

and $\alpha = \dfrac{v(1 - \delta s^{\circ})}{1 - \mu}$

We see that one condition for the stationary equilibrium is that $\delta s^{\circ} < 1$, i.e., the desired real wage must be such that if it is the ruling current rate, then the cost of each worker in terms of consumption goods, δs°, must be smaller than the value of his product. The constant δ = ad where a represents the incidence of wages in the unit price of nontraded goods d represents the incidence of domestic goods in the cost of living. Then its product δs^{o} is independent of the unit of measurement.

Finally the last three equations can be reduced to one equation in the rate of inflation:

$$(R^{o} - \frac{1 - \sigma}{n} \pi) \frac{\pi}{\varepsilon + \zeta s} + \Delta = \frac{\pi}{k} L(i(\pi), \pi)$$

where $s(\pi)$ is obtained from (9). This value is introduced in (8) from which we obtain $i(\pi)$. It can be seen that another condition for the equilibrium of system is that $L(i,\pi)$ must have a liquidity trap at a positive value for π and at a small positive level of i.

V. CONVERGENCE PROPERTIES INSTANTANEOUS EXPECTATIONS AND IMPERFECTLY ANTICIPATED INFLATION

We first study the stability of the system when the values of both σ and μ are less than unity due to institutional restrictions to the anticipation of inflation, and when the current inflation rate of commodity prices is expected to persist over time (instantaneous expectations).

Since it is a nonlinear system in the behavior of internaticaal capital flows, aggregate demand and the monetary asset demand, it has been approximated by Taylor's series around the stationary equilibrium values, retaining only the linear terms.

[1] The details of the transformations are left for the Appendix.

The strategy of solution adopted can be summarized as follows. We assume initially that the value of n is small in order to simplify the estimation of the Jacobian, so as to be able to decompose it into two independent subsystems, one for wages and the other for foreign exchange reserves and real money balances.

If n is negligible, we can write the complete matrix:

	m	h	s
$\dot{m}$	$-\pi - w$	π/P	-
$\dot{R}$	$-wP$	0	-
$\dot{s}$	0	0	ηy_s

were $$w = (B_i + K_i)\frac{k}{L_i(-P)} > 0$$

As for salaries the subsystem is stable, i.e., $\dot{s}_s < 0$:

$$\dot{s}_s = \eta_s(y - z) + \eta y_s$$

We know that $(y - z) = 0$ and $y_s = -\frac{v}{1-\mu}\frac{\gamma}{(\gamma + \delta s)^2} < 0$

From the remaining second order Jacobian we see that the necessary and sufficient conditions for stability are met, since the trace is negative and the determinant is positive.

We may now ask whether or not this stability result is maintained for higher values of n.

It is possible to show that when the trace for the complete matrix of partial derivatives is calculated without neglecting terms, then the complete trace is the preceding one plus a term $\dot{R}_R$ where,

$$\dot{R}_R = ((B_i + K_i) \frac{L_\pi}{L_i} \xi + K_i (1 - \sigma) (1 - \xi)) z_R$$

When n increases, the trace becomes positive and the system unstable, because $z_R = \frac{-n}{1 - \sigma}$.

To summarize this case, we found that the system is locally stable when n is negligible. On the other hand, when n is large the system is unstable. Then, due to the continuity of all functions involved the economy is stable for small and positive values of the coefficient of adjustment of the exchange rate to the gap of international reserves.

VI. INSTANTANEOUS EXPECTATIONS AND PERFECTLY ANTICIPATED INFLATION

In this section, let us explore the sensibility of the stability results when all economic agents, including the government, are able to anticipate fully the rate of inflation.

That is, the assumption about the generation of inflationary expectations of the last section is maintained but now the adjustment of nominal wages and of the rate of exchange to the expected inflation rate is full, i.e., $\mu = \sigma = 1$.

In this case, the complete equation system can be written as follows:

(1) $\dot{m} = \frac{\rho R + \dot{R}}{P} + \Delta - (\rho + \frac{\dot{P}}{P})m$

(2) $km = L(i,\pi)$

(3) $\dot{R} = B(i,P_h) + K(i + \pi - \rho)$

(4) $\frac{\dot{s}}{s} = v(s^\circ - \frac{s}{\gamma + \delta s}) + \pi - \rho$

(5) $\frac{\dot{P}}{P} = \pi - \rho$

(6) $\frac{\dot{r}}{r} = n(R^\circ - R) + \pi$

(7) $P = \varepsilon + \zeta s$

where $\gamma = (c + db)P_i$, $\delta = da$ and $\varepsilon = (e + bf)P_i$

If we denote by $\lambda = \frac{d \log P}{d \log s} = \frac{\zeta s}{\varepsilon + \zeta s}$ the elasticity of the general price levelas given by equation (7) with respect to wages then:

$$\pi - \rho = \lambda \frac{\dot{s}}{s}$$

This result can be used in (4) in order to have the behavior of wages

$$(8) \quad \frac{\dot{s}}{s} = \frac{v}{1 - \lambda} (s^{o} - \frac{s}{\gamma + \delta s})$$

$$= \frac{V}{1 - \lambda} \quad \frac{\gamma(s^* - s)}{(\gamma + \delta s^*) \ (\gamma + \ \delta s)}$$

It is seen that if the stationary equilibrium condition which was found is Section IV, $\delta s^{o} < 1$, is met, then s^* will be positive and in (8) $(s^* - s)$ has a positive coefficient. Then, $s(t) \to s^*$

$$t \to \infty$$

and the time path of wages becomes independently determined with respect to the exchange rate policy[1], without any assumption on the value of n.

We see then that equations (4), (5) and (7) allow us to determine independently the time path of wages. It becomes then determined by the price policy of firms and wage policy of labor unions because the effect of the minidevaluations is absorbed by the increase in the domestic rate of inflation.

In other words, since ρ and π are the same, $(\rho - \pi)$ is zero and so prices and wages in bancor do not change.

Let us now study the convergence conditions for the remaining variables.

From (7) the time path of the general price level is obtained. Hence $\frac{\dot{P}}{P}$ can be calculated. Then, from (6) and $\rho = \dot{r}/r$ we have that, for $\psi = \pi - \rho$: the time path of international reserves can be written as:

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[1]If $s > s^*$ (actual wages greater than equilibrium wages) the parenthesis of (8) will be negative. Hence $\dot{s}$ will be negative and wages converge monotonically to equilibrium since v and $(1 - \lambda)$ are positive.

$$R(t) = R^{\circ} + \frac{\psi(t)}{n}$$

This expression requires at $t = 0$,

$$R(0) = R^{\circ} + \frac{\psi(0)}{n}$$

That is, we found a severe restriction to the possible combinations of R° and n that may exist. If the above condition is met, the stability condition of the complete system becomes reduced to that of the following two equations in π (expected rate of inflation) and m (real cash balances), with the starred variables denoting equilibrium values:

$$(9) \qquad \dot{m} = \Delta - \pi\left(m - \frac{R^{\circ}}{P^*}\right)$$

$$(10) \qquad km = L(i^*, \pi)$$

This reduced system has a solution when the money asset demand function L has a liquidity trap for positive values of π and positive and small values of i^*.

The solution is stable because in (9) we see that if m increases from its equilibrium value with π constant, $\dot{m}$ becomes negative. That increase in m will have, through (10), a feedback on π, but due to the liquidity trap this effect will not be sufficient to offset the direct effect of the change in m.

Summarizing, the stability of crawling peg n this case requires a perfect coordination of wage and exchange rate policies. In particular, the Government does not have the possibility of freely choosing the values of n and of R.

The consistency condition that must be met can be derived as follows. We know from (6) and $\dot{r}/r = \rho$ that,

$$- n(R^{\circ} - R) = \pi - \rho$$

From (5) we know that $\pi - \rho = \lambda \frac{\dot{s}}{s}$.

Then (8) permits us to write the condition of consistency as:

$$\lambda v\left(s^{\circ} - \frac{s}{\gamma + \delta s}\right) + (1 - \lambda)\, n\, (R^{\circ} - R) = 0$$

The coordination of the wage and crawling peg policies has to be such that the weighted sum of the two gaps must be zero, where the weight is given by the value of the elasticity of the general price level with respect to wages. If this condition is met, stability is reached. Otherwise the system becomes inconsistent.

VII. ADAPTIVE EXPECTATIONS OF INFLATION

Given the result of the last section one may naturally ask whether the strong consistency condition is due to the assumption of perfect anticipation itself or to the way expectations were generated.

That is, we now assume that expectations of inflation are revised at each instant of time in proportion to the forecasting error (adaptive expectations) and at the same time retain the unitary values for the coefficients μ and σ. Then , equation (5) of the last section is now written as:

$$\dot{\pi} = \alpha(\rho + \frac{\dot{p}}{p} - \pi)$$

where α represents the positive expectation's coefficient. Two possibilities were considered. In the first, called the case of uniform expectations, both the public and the private sector react to the forecast error with the same coefficient, whereas in the second situation there are nonuniform expectations, i.e., the public sector has better inflation forecasts, due to smaller costs of information. Starting with the second case of nonuniform expectations let us notice that the Government adjusts the rate of the crawl to the actual current rate of inflation and to the gap of reserves.

$$\frac{\dot{r}}{r} = n(R^{c} - R) + \frac{\dot{r}}{r} + \frac{\dot{p}}{p}$$

from which it can be deduced that the inflation rate equals the negative of the adjustment to the gap of reserves:

$$\frac{\dot{p}}{p} = - n(R^{\circ} - R)$$

Let us write the complete equation sytem corresponding to this case:

$$\dot{m} = (\rho R + \dot{R})/P + \Delta - (\rho + \frac{\dot{p}}{p})\ m$$

$$km = L(i,\ \pi)$$

$$\dot{R} = B(i,\ as + \beta) + K(i + \pi - \rho)$$

$$\frac{\dot{s}}{s} = v(s^{\circ} - \frac{s}{\gamma + \delta s}) + \pi - \rho$$

$$\dot{\pi} = \alpha(\rho + \frac{\dot{p}}{p} - \pi)$$

$$\frac{\dot{p}}{p} = - n(R^{\circ} - R)$$

$$P = \varepsilon + \zeta s$$

At any instant, it is possible to obtain the temporary equilibrium of the system from its past history, which gives us the current values of the five dynamic variables (P, s, π, R and m), and from the predetermined variables.[1]

Hence the temporal path of the economy is determined.

Let us study now the way the system reacts to any disturbance by analyzing again its local stability properties. First, the system will be reduced to one of four dynamic equations. Second the functions B, K and L will be expanded around their stationary equilibrium values in which by definition:

[1]The task is facilitated due to the triangularity of the system.

$$R^{\circ} = R, \; s^{\circ} = s/(\gamma + \delta s), \quad \pi = \rho$$

That is, $\dot{s} = \dot{P} = \dot{\pi} = \dot{R} = \dot{m} = 0$ in stationary equilibrium.

The system can be reduced to the following four equations whose stability will be analyzed through the estimation of the corresponding Jacobian and the application of the Routh-Hurwicz conditions.

$$\dot{s} = = \frac{ns}{\lambda}(R^{\circ} - R)$$

$$\pi = \alpha[v(s^{\circ} - \frac{s}{\gamma + \delta s}) + (\frac{1}{\lambda} - 1)(R^{\circ} - R)]$$

$$\dot{R} = B(i, as + \beta) + K(i - v(s^{\circ} - \frac{s}{\gamma + \sigma s}) - \frac{n}{\lambda}(R^{\circ} - R))$$

$$\dot{m} = (\frac{R}{P} - m)(v(s^{\circ} - \frac{s}{\gamma + \sigma s}) + \pi + \frac{n}{\lambda}(R^{\circ} - R) + \frac{B + K}{P} +$$

$$+ \Delta - mn(R^{\circ} - R)).$$

Following a strategy similar to the one used in section V, we start by analyzing the stability of the system for the case in which the product of the coefficient of adjustment of the crawl to reserves and the expectations coefficient is null $(\alpha \,.\, n) = 0$. Thereafter this assumption is relaxed to see the effect on some or all the stability conditions.

The application of this strategy revealed that the crawling peg policy is always locally stable for small values of n and α

The crucial coefficient for stability is n, because given any value of α, it is always possible to find a value for n such that the system becomes unstable.

What can be said in the case of uniform adaptive expectations of inflation for all private and public decision makers? Will the system increase the possibilities of convergence?

It is possible to show that in this case stability becomes independent of the value of the common expectations coefficient. Furthermore it is interesting to notice that the estimation of all Routhian conditions becomes unnecessary. This is because when n is zero, A, the matrix of the system, can be decomposed into two square submatrices along its main diagonal, such that,

$$A = \left[\begin{array}{cc|cc} -\pi & 0 & m\lambda x - \zeta R\pi & -\frac{\Delta}{\pi} \\ -Pwk & -wk & Pz & PwL_{\pi} \\ \hline 0 & 0 & -sx & 0 \\ 0 & 0 & -\alpha\lambda x & 0 \end{array}\right]$$

$$x = \frac{v\gamma}{(\gamma + \delta s)^2} \qquad w = \frac{B_i + K_i}{-PL_i}$$

$$J = \frac{nK_i}{P} \qquad z = \frac{aBP_h}{P}$$

The characteristic roots can be directly read. They are $(-\pi)$ and $(-wk)$ for the first submatrix, and $(-sx)$ and zero for the second. Hence the system does not converge simultaneously in its four directions.

What happens now if we relax the assumption of zero $\alpha.n$? Since the roots are continuous functions of the coefficients of the characteristic polinominal and we know that the first three roots are negative, then if the determinant is positive, the fourth root will necessarily become negative for small $\alpha.n$. As a matter of fact,

$$\text{Det } A = \alpha nsxPw(L_\pi \pi + k \frac{\Delta}{\pi}) > 0$$

which is positive when $k \frac{\Delta}{\pi} > \pi \, (-L_\pi)$

Hence through the verification of only one stability condition, we are in fact verifying the stability of the complete system.

We conclude then that stability will depend on the responsiveness of the asset demand function to π. If it is small, the system is stable. Furthermore it is easily seen than when the value of n becomes very large, as when the Government tries to maintain at all times a desired level of foreign exchange reserves, the Trace of A becomes positive and the system unstable.

We observe that the generalization of the adaptive model for the formation of expectations to almost all sectors of the economy, increases its stability which in turn becomes independent of the uniform α.

VIII. CONCLUSIONS

We have then completed the study of one possible way of approaching the problem of convergence over time of the crawling peg for a small open economy subject to internal inflationary pressures. The crawling peg was seen as a policy of limited exchange rate flexibility that maintains the competitiveness of the foreign trade sector while avoiding disruptive international capital flows.

It is a simplified analysis which assumed non-Walrasian adjustment processes for the different endogenous market price variables, introducing the notion of real wage resistance in the case of the labor market.

A more complete study should admit the existence of some dual dynamic behavior in which markets like those for raw materials and agricultural products are likely to exhibit the flexibility embedded in the traditional Walrasian response to ex-ante excess demand.

Several cases have been analyzed which can be summarized as follows. In the first case studied the current inflation rate was both expected to persist and imperfectly anticipated by private and public decision makers. The system is found to be stable if and only if the coefficient of adjustment of the exchange rate to the change in the stock of foreign reserves is small.

In the limiting case of a zero adjustment coefficient the model can be decomposed into two independent stable sub-systems, one for wages and the other for foreign exchange reserves and real cash balances.

The second case studied maintains the assumption of instantaneous expectations of change in the commodity price level while admitting perfect anticipation of inflation. That is in this case the crawling peg is studied under minimum "a priori" conditions for the existence of damping factors in the price-wages-exchange rate spiral. It is shown in this case convergence over time of the whole system requires the fulfillment of a consistency condition under the form of a perfect coordination of wages and exchange rate policies. This condition requires that the weighted sum of the gaps desired wages-actual real wages, and desired reserves-current-reserve stocks be equal to zero, with the weights given by the elasticity of the general price level with respect to wages. The Government, in other words, is not free to choose simultaneously the values of the desired stock of foreign reserves and of the adjustment coefficient to the change in reserves. If this consistency condition is met, stability is found to become independent of the adjustment velocities.

At this point we asked the extent to which the consistency condition was due to the way in which expectations of inflation were generated. That is, the adaptive expectation's model was introduced, while maintaining the hypothesis of perfect anticipated inflation (absence of legal or institutional restrictions). Two possibilities were distinguished. In the first, labor unions and the government react to forecasting errors with a uniform expectation coefficient. In the second alternative the public sector, due to smaller costs of information, has a unitary anticipation's coefficient.

When expectations are adaptive and uniform, the system is found to converge in all but one of its direction's, if the coefficient of adjustment of the rate of exchange to the change in reserves is null.

When this coefficient is small and positive, stability depends on the value of the elasticity of the demand for real cash balances to the expected rate of inflation. If this parameter is zero, the system is stable.

An interesting feature of this case of uniform expectations is that the complete Jacobian can be decomposed in such a way that there is no need to calculate the Routh-Hurwicz conditions.

Finally when expectations are adaptive and anticipations are non-uniform we have found that given the value of adjustment of the rate of the crawl to reserves, it is always possible to find a value for the forecasting error coefficient such that some condition of stability becomes violated. On the other hand, for a given value of the second parameter, we can always find a value for the first that destabilizes the system.

It is not easy to trace back the precise economic interpretation to be given to the small value for the adjustment of the rate of the crawl(or large lag) to the change in foreign reserves, that we have found as a sort of common denominator for stability in most of the cases studied.

Nevertheless it represents a confirmation of the key role that foreign exchange reserves play in a system of limited exchange rate flexibility.

Reserves should not be tried to be kept at desired levels all the time. They must be used instead to finance external balance of payments disequilibrium given the rate of the crawl. Otherwise, any change in reserves irrespective of its cause, will "trigger" rapid changes in the rate of the crawl--which means a large adjustment coefficient for reserves--and the system becomes unstable.

This result implies that in our model a system of perfectly flexible exchange rates would be unstable. If the rate of exchange is perfectly flexible, by definition, the change in reserves would be permanently zero since the price of the foreign currency would be that at which excess demand for foreign exchange is continuous null.

The conclusions seem to agree with the results obtained by Kenen 1975 [37] in a large simulation study of alternative methods for changing exchange rates.

He found that the glide based on the equilibrium rate "seems to be the best from every point of view[1] better even than full exchange rate flexibility". And at the opposite extreme "the glide based on the level of reserves is the worst."

[1] The notion of stability used in the simulations was in terms of the amplitude of fluctuations in the exchange rate and in the volume of trade.

REFERENCES

[1] Alexander, S. (1952) "Effects of devaluation on the trade balance", International Monetary Fund Staff Papers, April.

[2] Arndt, S., (1971), "The Comparative merits of fixed versus flexible exchange rates. Comment." Journal of Money, Credit and Banking, May.

[3] Black, J. (1966), "A Proposal for the Reform of Exchange Rates", Economic Journal, June.

[4] Carrasco C. and French Davis R (1969), "Chile: cuatro años de experiencia con una nueva politica de tipo de cambio" CEMLA, Boletin Mensual, Junio 1969.

[5] Cooper, R. [1970] "Flexing the International Monetary System. The Case for Gliding Parities", Ch. 14 in Johnson H. and Swoboda A. The Economics of Common Currencies (G. Allen and Unwin 1973).

[6] Cooper, R. (1971) "Currency Devaluation in Underdeveloped Countries", in Ranis (Ed.) Government and Economic Development, (Yale University Press).

[7] Diaz Alejandro, C. (1975) Colombian Foreign Trade System Ch. 7, Mimeo, Project National Bureau of Economic Research.

[8] Dornbush, R. (1974), "Real and Monetary Aspects of Exchange Rate Changes", in Aliber R. (Ed.), National Monetary Policies and the International Financial System (Chicago University Press).

[9] Fellner, W. (1966), "On limited Exchange Rate Flexibility", in Cooper, R. (ed.) International Finance.

[10] Fishlaw , A. (1974) "Indexing Brazilian Style: Inflation Without Tears?" Brookings Papers on Economic Activity, 1.

[11] Genberg, H. and Swoboda, A., 1974, Protection against Inflation. The Role of Indexation, (International Center for Monetary Studies, Geneva.)

[12] Giersch, H. (1974) "Index Clauses and the Fight Against Inflation" in Giersch H. Friedman, M., Fellner, U. et al Essays on Indexation and Inflation, (American Enterprise, Washington 1974).

[13] Grubel, H. (1966), Forward Exchange, Speculation, and the International Flow of Capital (Stanford University Press).

[14] Hicks, J. (1965), Capital and Growth, (Oxford, Clarendon Press).

[15] Hicks, J. (1975), "What is Wrong with Monetarism", Lloyds Bank Review No. 118, October 1975.

[16] Hicks, J. (1974), The Crisis in Keynesian Economics (Basic Books, Inc., New York, 1974).

[17] Johnson, H. (1973), "The Monetary Approach to Balance of Payments Theory", Ch. 11 in Connolly M. and Swoboda, A. (ed.) International Trade and Money (G. Allen and Unwin).

[18] Krueger, A. (1969), "Balance of Payments Theory", Journal of Economic Literature, March.

[19] Kuska, E. (1972), "The Pure Theory of Devaluation", Economica, August.

[20] Levin, J. (1970), Forward Exchange and Internal-External Equilibrium (Michigan Studies No. 12).

[21] Lutz, F. (1966), "Monetary rates of interest, real rates of interest and capital movements", in Fellner W., Machlup F., Triffin, R. et al., Maintaining and Restoring Balance in International Payments (Princeton University Press).

[22] Martirena-Mantel, Ana M. (1975) "Propiedades de Convergencia de un siste ma generalizado de tipos de cambio reptantes", Instituto Ti DiTella, May (mimeo).

[23] Matarazzo Suplicy (1973), "Minidevaluations in the Brazilian Economy," (Unpublished Ph.D., Michigan University).

[24] Meade, J. (1951), The Theory of International Economic Policy, Vol. 1, The Balance of Payments (London, Oxford University Press).

[25] Meade, J. (1966), "Exchange Rate Flexibility", Three Banks Review, June. Also

[26] Mussa, M. (1975), "A Monetary Approach to Balance of Payments Analysis", Journal of Money, Credit and Banking.

[27] Olivera, J. (1970), "On Passive Money", Journal of Political Economy, July/August.

[28] Parkin M. and Laidler D. (1975) "Inflation: A Survey" Economic Journal December 1975, p. 741-797.

[29] Robichek W. and Sanson C. (1972) "The Balance of Payments Performance of Latin America and the Caribbean", IMF Staff Papers, July 1972.

[30] Salop, J. (1974), "Devaluation and the Balance of Trade Under Flexible Wages", in Horwich G. and Samuelson, P. (Editors), Trade, Stability and Macroeconomics. Essays in Honor of L. Metzler (Academic Press).

[31] Salter W., (1959), "Internal and external balance--the role of price and expenditure effects", Economic Record, August.

[32] Tobin, J. (1969), "A General Equilibrium Approach to Monetary Theory", Journal of Money Credit and Banking, February.

[33] Tsiang S. (1961) "The role of money in trade balance stability. Synthesis of elasticity and absorption approach", in Cooper, R. (Editor) International Finance (Penguin).

[34] Willet T., Katz S. and Branson W., (1970), Exchange Rate Systems, Interest Rates and Capital Flows" Essays in International Finance No. 78, January 1970 (Princeton University).

[35] Williamson (1965) "The Crawling Peg", Essays in International Finance No. 50, December.

[36] Kenen, P. (1975) "Floats, glides and indicators-A comparison of methods for changing exchange rates", Journal of International Economics, No. 2, May.

[37] Swan, T. (1960) "Economic Control in a Dependent Economy", Economic Record, March.